Aerosol Corrections for Safari 2000

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MS Electron 3 wavelength nephelometer

These formulas correct the MS 3 wavelength nephelometer for the angular truncation problem and for the non-isotropic light source problem. The equations for the total scattering parameter corrections are from Seth Hartley's Masters thesis equations 3.6, 3.7a, 3.7b, and 3.7c. The equations for the backscatter parameter corrections are from Seth Hartley's Masters thesis equations 4.5a, 4.5b, and 4.5c. Errors associated with these corrections are discussed in the thesis and, although they are small, should be examined.

alphabg = -log(nepblu/nepgrn)/log(450/550)
cblu = 1.238-0.080*alphabg
nepblu_c = nepblu*cblu

alphabr = -log(nepblu/nepred)/log(450/700)
cgrn = 1.233-0.077*alphabr
nepgrn_c = nepgrn*cgrn

alphagr = -log(nepgrn/nepred)/log(550/700)
cred = 1.204-0.064*alphagr
nepred_c = nepred*cred

bkspbl_c = bkspbl*0.935
bkspgr_c = bkspgr*0.955
bksprd_c = bksprd*0.979

Particle soot/absorption photometer

The original PSAP measurements are made at 567 nm (confirmed with Ray Weiss May 2002 and stated in Bond et al, Calibration and Intercomparison of Filter-based Measurements of Visible Light Absorption by Aerosols, *Aerosol Science and Technology*, v.30, 582-600, 1999). Thus, the first correction is to adjust the PSAP measurements to 550 nm wavelength so they can be directly compared with the 3 wavelength nephelometer scattering values at 550 nm. The correction is based on the assumption of a 1/wavelength dependence for absorption coefficient in the visible (discussed in Hartley et al, Properties of aerosols aloft relevant to direct radiative forcing off the mid-Atlantic coast of the United States, *JGR*, v. 105, 9859-9885, 2000). Since the correction is small, the assumption should be valid.

Since the flow meter on the PSAP reduces all flow rates to STP (standard temperature of 288K and pressure of 1013.25 hPa), the absorption coefficient values are first converted to ambient pressure and temperature (using pstat and tstatr) via the Perfect Gas law equation. This is done because the nephelometer makes measurements at ambient pressure and temperature.

The next formula corrects the PSAP absorption coefficient measurements for the errors and inconsistencies discussed in the Bond et al 1999 paper mentioned above. The Bond et al 1999 corrections are all stated for 550 nm, which we have already adjusted our measurements to. Important values for the PSAP used to complete the Bond et al 1999 correction are the measured filter spot size of 4.7mm (smaller than the calibrated 5.1mm) and a 30 second averaging time. The internal PSAP flow meter was not checked and thus no correction for the flow meter is applied (inaccuracies in the flow meter are thought to introduce no more than 10% inaccuracy in the PSAP measurements, although Bond et al note that flow meters were up to 20% inaccurate).

rams550 = rams*567/550
rams550_amb = rams550*(pstat/1013.25)*[288/(tstatr+273.15)]
rams550_amb_c = rams550_amb*(4.7/5.1)^2
rams550_amb_c = [rams550_amb_c – 0.02*nepgrn + 0.06*rams550_amb_c +
0.18*sqrt(24/0.5)*1e-6]/1.22